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## PATENT COOPERATION TREATY

PCT

NOTIFICATION OF ELECTION  
(PCT Rule 61.2)

From the INTERNATIONAL BUREAU

To:

United States Patent and Trademark  
Office  
(Box PCT)  
Crystal Plaza 2  
Washington, DC 20231  
ÉTATS-UNIS D'AMÉRIQUE

in its capacity as elected Office

Date of mailing (day/month/year) 02 March 1999 (02.03.99)	To: United States Patent and Trademark Office (Box PCT) Crystal Plaza 2 Washington, DC 20231 ÉTATS-UNIS D'AMÉRIQUE  in its capacity as elected Office
International application No. PCT/NL98/00368	Applicant's or agent's file reference F Hw/Aw/7TNO
International filing date (day/month/year) 25 June 1998 (25.06.98)	Priority date (day/month/year) 04 July 1997 (04.07.97)
<b>Applicant</b> JANSSENS, Marcel, Henk, André	

## 1. The designated Office is hereby notified of its election made:

 in the demand filed with the International Preliminary Examining Authority on:

01 February 1999 (01.02.99)

 in a notice effecting later election filed with the International Bureau on:2. The election  was was not

made before the expiration of 19 months from the priority date or, where Rule 32 applies, within the time limit under Rule 32.2(b).

The International Bureau of WIPO 34, chemin des Colombettes 1211 Geneva 20, Switzerland  Facsimile No.: (41-22) 740.14.35	Authorized officer S. Cruz  Telephone No.: (41-22) 338.83.38
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# PATENT COOPERATION TREATY

## PCT

### INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference F Hw/Aw/7TNO	FOR FURTHER ACTION		See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416)
International application No. PCT/NL98/00368	International filing date (day/month/year) 25/06/1998	Priority date (day/month/year) 04/07/1997	
International Patent Classification (IPC) or national classification and IPC E01B19/00			
<b>Applicant</b> <b>NEDERLANDSE ORGANISATIE VOOR TOEGEPAST. ....et al.</b>			
<p>1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.</p> <p>2. This REPORT consists of a total of 5 sheets, including this cover sheet.</p> <p><input checked="" type="checkbox"/> This report is also accompanied by ANNEXES, i.e. sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).</p> <p>These annexes consist of a total of 3 sheets.</p>			
<p>3. This report contains indications relating to the following items:</p> <ul style="list-style-type: none"> <li>I   <input checked="" type="checkbox"/> Basis of the report</li> <li>II   <input type="checkbox"/> Priority</li> <li>III   <input type="checkbox"/> Non-establishment of opinion with regard to novelty, inventive step and industrial applicability</li> <li>IV   <input type="checkbox"/> Lack of unity of invention</li> <li>V   <input checked="" type="checkbox"/> Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement</li> <li>VI   <input type="checkbox"/> Certain documents cited</li> <li>VII   <input checked="" type="checkbox"/> Certain defects in the international application</li> <li>VIII   <input checked="" type="checkbox"/> Certain observations on the international application</li> </ul>			
Date of submission of the demand 01/02/1999	Date of completion of this report <b>20. 10. 99</b>		
Name and mailing address of the international preliminary examining authority:  European Patent Office - P.B. 5818 Patentlaan 2 NL-2280 HV Rijswijk - Pays Bas Tel. +31 70 340 - 2040 Tx: 31 651 epo nl Fax: +31 70 340 - 3016	Authorized officer <b>Kergueno, J</b> Telephone No. +31 70 340 2369		



**INTERNATIONAL PRELIMINARY  
EXAMINATION REPORT**

International application No. PCT/NL98/00368

**I. Basis of the report**

1. This report has been drawn on the basis of (*substitute sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to the report since they do not contain amendments.*):

**Description, pages:**

4-6	as originally filed	
1,2	with telefax of	27/09/1999

**Claims, No.:**

1-7	with telefax of	27/09/1999
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**Drawings, sheets:**

1/2,2/2	as originally filed
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2. The amendments have resulted in the cancellation of:

the description,      pages:  
 the claims,      Nos.:  
 the drawings,      sheets:

3.  This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed (Rule 70.2(c)):

4. Additional observations, if necessary:

**INTERNATIONAL PRELIMINARY  
EXAMINATION REPORT**

International application No. PCT/NL98/00368

**V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement**

**1. Statement**

Novelty (N)	Yes:	Claims 2-4,6,7
	No:	Claims 1,5
Inventive step (IS)	Yes:	Claims 2
	No:	Claims 1,3-7
Industrial applicability (IA)	Yes:	Claims 1-7
	No:	Claims

**2. Citations and explanations**

**see separate sheet**

**VII. Certain defects in the international application**

The following defects in the form or contents of the international application have been noted:

**see separate sheet**

**VIII. Certain observations on the international application**

The following observations on the clarity of the claims, description, and drawings or on the question whether the claims are fully supported by the description, are made:

**see separate sheet**

**Re It m V**

**Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement**

1. Document DE-C-916830 discloses with reference to fig.2 a rail track comprising two parallel rails of asymmetrical cross-section supported by a non-compressible base body provided with a channel-like recess for receiving the rail such that the running surface of the head of the rail lies free, wherein the bottom of the channel-like recess is provided with a layer of yielding, sound-damping material which extends under the bearing surface of the foot of the rail and covers the surface between the running surface and the bearing surface of the rail.

In this prior art, the term "filling" is linked to forming the layer of the referred-to embodiment, while the term "casting" is used for the embodiment of fig.1 when related to the lateral portions of the rail, the base portion being explicitly a separate layer. In this context, it is implicit from the disclosure that the layers in fig.2 deserve the appellation of first, respectively second layer as in present claim 1.

The application therefore does not fulfill the criteria set forth in Article 33(2), the subject matter of claim 1 and of claim 5 as appended thereon being deprived of novelty.

2. Claims 3, 4, 6, 7 when appended on claim 1 do not appear to support an inventive step within the meaning of Article 33(3) for the following reasons:

- claim 3; the features are linked to current railway regulations and are further suggested by document US-A-4775103, col.4/l.40-47;
- claim 4; though it is not clear whether the differences in stiffness are to link to the geometry or implementation of the respective layers or to the layer material itself, the features are considered to fall within current design practice linked to the differences in lateral rail loading;
- claim 6; the provision of interruptions, deemed to be linked to the recesses illustrated on fig.2, lies close to the cavities 10 in said US-A-4775103, fig.1;
- claim 7; the tarmac layer 20 in US-A-5513797 inherently has to a certain extent sound absorbing properties.

**INTERNATIONAL PRELIMINARY  
EXAMINATION REPORT - SEPARATE SHEET**

International application No. PCT/NL98/00368

3. The features introduced by claim 2, subject to item VIII, are neither known nor suggested by the state of the art as defined in rule 64.1. Filler bodies are known in a similar context from document US-A-4775103, though being implemented between the rail and the yielding layer, which is itself in direct contact with the channel-like recess. Filler bodies respectively arranged between a channel-like recess of a railway sleeper and a yielding layer extending over the lateral faces of a rail are known from DE-C-4415892. Sleepers are here construed not to fall within the intended meaning of the term "base body" in the present application. As rail supports in the form of sleepers cannot provide an acoustic insulation of the rail portions extending between the sleepers, the document is not relevant for assessment of inventive step.

The subject-matter of claim 2, and therefore of claims 3-7 when appended on said claim therefore fulfill the criteria set forth in Article 33(1).

**Re Item VII**

**Certain defects in the international application**

Document DE-C-916830, which is considered to represent the relevant state of the art, should have been cited in the description, Rule 5.1 a) ii).

**Re Item VIII**

**Certain observations on the international application**

1. There is no antecedent in claim 1 to the term "the space" in claim 2, whereby the subject-matter of claim 2 is rendered unclear, contrary to Article 6. It is further to note that the provision of such a space is not consistent with the embodiments of figs. 1, 4 and 6.

2. The expression "non-compressible base body" in claim 1 does not unambiguously preclude said body to be a transverse sleeper, such an interpretation not being supported by the description, contrary to Article 6.

30. 09. 1999

F TP72/Aw/7

PCT/NL98/00368/27-09-1999

(59)

RAIL TRACK HAVING ENHANCED ABSORPTION OF VIBRATION AND SOUND

The present invention relates to a rail track comprising at least two parallel rails supported by a non-compressible base body, wherein the base body is provided with a channel-like recess for receiving the 5 rail such that the running surface of the head of the rail lies free, wherein the bottom of the channel-like recess is provided with a first layer of yielding material which extends under the bearing surface of the foot of the rail.

10 In many rail tracks the rails are connected with sleepers which lie on a base body, for instance gravel. An alternative is to mount the rails on a concrete slab or on a steel bridge.

15 Through rolling of the wheels of the train over the rails and as a result of the unevenness occurring on the wheels and rails, the wheels and the rails will be set into vibration. The vibrations in the rails become weaker as the distance relative to the contact point between wheel and the rail becomes larger. The reason that these 20 vibrations become weaker is partly the result of dissipation in the rail but is caused to a much greater extent because the energy from the rail related to the vibrations is discharged to the base body via the rail support. A part of this discharged energy will be 25 dissipated in the rail supports themselves and a part of this energy will be dissipated in the base body.

A resilient element is generally arranged between the rails and the sleepers, the concrete slab or the steel bridge. This is done to reduce the exchange of 30 forces from the rail to the base body, whereby the lifespan of the rail and the base body is prolonged. For this purpose the railway companies for instance apply the

regulation that the rails must undergo a displacement of 1.5 to 2.5 mm at an axle load of 22.5 tons.

In addition, the transfer of vibrations to the base body is reduced by this resilient rail support. The 5 resilient element insulates the vibrations, which results in a reduction of the vibration level of the base body and to a reduction in the sound radiation from the base body. The result of a better vibration insulation is that the rail will begin to vibrate more strongly and 10 therefore becomes a more significant source of noise.

Another sound-damping system for rail tracks known from WO-A-9110778 is casting flexible material in the rail. This system has the drawback that the rail begins to radiate sound more efficiently because the casting 15 mass acts as reflector for the sound radiated by the rail and because the casting mass begins to function as an extra source of noise. In addition, use is made herein of a large volume of expensive polymer material to fix the rail.

20 On the basis of the foregoing, it can be concluded that acoustic measures will have to be taken in a balanced manner in order to reduce the total noise level of all sources together and to obtain an improved vibration damping of the rail track.

25 The object of the present invention is to achieve a reduction in the noise production of rail tracks while still complying with the regulation of the railway companies. For this purpose a rail track is provided wherein the surface between the running surface and the 30 bearing surface of the rail is covered with a second layer of yielding material.

See further original description, page 2, line 29.

EPO - DG 1  
30. 09. 1999

(59)

CLAIMS

1. Rail track comprising at least two parallel rails (2) supported by a non-compressible base body (1), wherein the base body (1) is provided with a channel-like recess (3) for receiving the rail such that the running surface (5) of the head (4) of the rail lies free, wherein the bottom (8) of the channel-like recess (3) is provided with a first layer (9) of yielding material which extends under the bearing surface of the foot (7) of the rail, characterized in that the surface between the running surface (5) and the bearing surface (7) of the rail is covered with a second layer (10) of yielding material.

2. Rail track as claimed in claim 1, characterized in that the space between the second layer (10) and the channel-like recess (3) is filled with a filler body (12) of non-compressible material.

3. Rail track as claimed in claim 1 or 2, characterized in that the second layer (10) has a greater stiffness than the first layer (9).

4. Rail track as claimed in any of the foregoing claims, characterized in that the second layer (10) has on the one side of the rail (2) a different stiffness than on the other side.

5. Rail track as claimed in any of the foregoing claims, characterized in that the cross-section of the rail (2) is asymmetrical.

6. Rail track as claimed in any of the foregoing claims, characterized in that the first and/or second layer (9, 10) of yielding material is interrupted.

7. Rail track as claimed in any of the foregoing claims, characterized in that the upper side of the base body (1) is provided with a layer (11) of sound-absorbing material.

## PATENT COOPERATION TREA..

## PCT

## INTERNATIONAL SEARCH REPORT

(PCT Article 18 and Rules 43 and 44)

Applicant's or agent's file reference <b>F Hw/Aw/7TNO</b>	<b>FOR FURTHER ACTION</b> see Notification of Transmittal of International Search Report (Form PCT/ISA/220) as well as, where applicable, item 5 below.	
International application No. <b>PCT/NL 98/ 00368</b>	International filing date (day/month/year) <b>25/06/1998</b>	(Earliest) Priority Date (day/month/year) <b>04/07/1997</b>
Applicant <b>NEDERLANDSE ORGANISATIE VOOR TOEGEPAST. ....et al.</b>		

This International Search Report has been prepared by this International Searching Authority and is transmitted to the applicant according to Article 18. A copy is being transmitted to the International Bureau.

This International Search Report consists of a total of 4 sheets.

It is also accompanied by a copy of each prior art document cited in this report.

1.  Certain claims were found unsearchable (see Box I).
2.  Unity of invention is lacking (see Box II).
3.  The international application contains disclosure of a nucleotide and/or amino acid sequence listing and the international search was carried out on the basis of the sequence listing
  - filed with the international application.
  - furnished by the applicant separately from the international application,
    - but not accompanied by a statement to the effect that it did not include matter going beyond the disclosure in the international application as filed.
  - Transcribed by this Authority
4. With regard to the title,  the text is approved as submitted by the applicant
  the text has been established by this Authority to read as follows:
5. With regard to the abstract,
  - the text is approved as submitted by the applicant
  - the text has been established, according to Rule 38.2(b), by this Authority as it appears in Box III. The applicant may, within one month from the date of mailing of this International Search Report, submit comments to this Authority.
6. The figure of the drawings to be published with the abstract is:
 

Figure No. 1

  - as suggested by the applicant.
  - because the applicant failed to suggest a figure.
  - because this figure better characterizes the invention.

None of the figures.

## INTERNATIONAL SEARCH REPORT

International application No

PCT/NL 98/00368

**B x III TEXT OF THE ABSTRACT (Continuation of item 5 of the first sheet)**

Rail track comprising at least two parallel rails (2) supported by a non-compressible base body (1), wherein the base body is provided with a channel-like recess for receiving the rail such that the running surface of the head of the rail lies free, wherein the bottom of the channel-like recess is provided with a first layer (9) of yielding material which extends under the bearing surface of the foot of the rail, and wherein the surface between the running surface and the bearing surface of the rail is covered with a second layer (10) of yielding material, so that an improved vibration damping and sound reduction are obtained.

## IN NATIONAL SEARCH REPORT

International Application No

PCT/NL 98/00368

**A. CLASSIFICATION OF SUBJECT MATTER**  
 IPC 6 E01B19/00 E01B9/68 E01B1/00

According to International Patent Classification(IPC) or to both national classification and IPC

**B. FIELDS SEARCHED**

Minimum documentation searched (classification system followed by classification symbols)

IPC 6 E01B E01C

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 91 10778 A (BRITISH STEEL) 25 July 1991 see page 2, line 1 - page 4, line 20; figure 1 ---	1,3-5
X	DE 916 830 C (DORTMUNDER UNION BRÜCKENBAU) 3 December 1953 see page 2, line 1-29; figure 1 ---	1,3-5
X	US 5 513 797 A (LESLEY) 7 May 1996 see column 2, line 64 - column 3, line 53; figures 1,2 ---	1,5,7
A	US 4 775 103 A (ORTWEIN) 4 October 1988 see column 5, line 1-6; figure 3 ---	1-3
A	DE 44 15 892 C (BAUUNTERNEHMUNG E.HEITKAMP) 17 August 1995 see figures 1,5 ---	6 -/-

 Further documents are listed in the continuation of box C. Patent family members are listed in annex.

## ° Special categories of cited documents :

- "A" document defining the general state of the art which is not considered to be of particular relevance
- "E" earlier document but published on or after the international filing date
- "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
- "O" document referring to an oral disclosure, use, exhibition or other means
- "P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search

Date of mailing of the international search report

21 September 1998

12/10/1998

Name and mailing address of the ISA

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Fax: (+31-70) 340-3016

Authorized officer

Kergueno, J

## IN NATIONAL SEARCH REPORT

International Application No

PCT/NL 98/00368

## C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	EP 0 771 908 A (STICHTING GELUIDARME SPOORBRUGGEN) 7 May 1997 -----	

## INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

PCT/NL 98/00368

Patent document cited in search report		Publication date	Patent family member(s)		Publication date
WO 9110778	A	25-07-1991	AU	7062691 A	05-08-1991
			CN	1054630 A	18-09-1991
			GB	2239884 A	17-07-1991
DE 916830	C		NONE		
US 5513797	A	07-05-1996	AT	120506 T	15-04-1995
			AU	636389 B	29-04-1993
			AU	6336790 A	03-04-1991
			DE	69018265 D	04-05-1995
			DE	69018265 T	24-08-1995
			EP	0489100 A	10-06-1992
			ES	2073033 T	01-08-1995
			GB	2235667 A,B	13-03-1991
			WO	9102843 A	07-03-1991
			JP	5500092 T	14-01-1993
US 4775103	A	04-10-1988	DE	3540128 A	14-05-1987
			EP	0222277 A	20-05-1987
DE 4415892	C	17-08-1995	NONE		
EP 771908	A	07-05-1997	NL	1001541 C	02-05-1997

## INTERNATIONAL SEARCH REPORT

Internal Application No  
PCT/NL 98/00368

## A. CLASSIFICATION OF SUBJECT MATTER

IPC 6 E01B19/00 E01B9/68 E01B1/00

According to International Patent Classification(IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 6 E01B E01C

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 91 10778 A (BRITISH STEEL) 25 July 1991 see page 2, line 1 - page 4, line 20; figure 1 ---	1,3-5
X	DE 916 830 C (DORTMUNDER UNION BRÜCKENBAU) 3 December 1953 see page 2, line 1-29; figure 1 ---	1,3-5
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A	US 4 775 103 A (ORTWEIN) 4 October 1988 see column 5, line 1-6; figure 3 ---	1-3
A	DE 44 15 892 C (BAUUNTERNEHMUNG E.HEITKAMP) 17 August 1995 see figures 1,5 ---	6
		-/-

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## \* Special categories of cited documents :

- "A" document defining the general state of the art which is not considered to be of particular relevance
- "E" earlier document but published on or after the international filing date
- "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
- "O" document referring to an oral disclosure, use, exhibition or other means
- "P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search

Date of mailing of the international search report

21 September 1998

12/10/1998

## Name and mailing address of the ISA

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Fax: (+31-70) 340-3016

Authorized officer

Kergueno, J

## C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	EP 0 771 908 A (STICHTING GELUIDARME SPOORBRUGGEN) 7 May 1997	

Patent document cited in search report		Publication date		Patent family member(s)		Publication date
WO 9110778	A	25-07-1991		AU 7062691 A		05-08-1991
				CN 1054630 A		18-09-1991
				GB 2239884 A		17-07-1991
DE 916830	C			NONE		
US 5513797	A	07-05-1996		AT 120506 T		15-04-1995
				AU 636389 B		29-04-1993
				AU 6336790 A		03-04-1991
				DE 69018265 D		04-05-1995
				DE 69018265 T		24-08-1995
				EP 0489100 A		10-06-1992
				ES 2073033 T		01-08-1995
				GB 2235667 A,B		13-03-1991
				WO 9102843 A		07-03-1991
				JP 5500092 T		14-01-1993
US 4775103	A	04-10-1988		DE 3540128 A		14-05-1987
				EP 0222277 A		20-05-1987
DE 4415892	C	17-08-1995		NONE		
EP 771908	A	07-05-1997		NL 1001541 C		02-05-1997

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WORLD INTELLECTUAL PROPERTY ORGANIZATION  
International Bureau



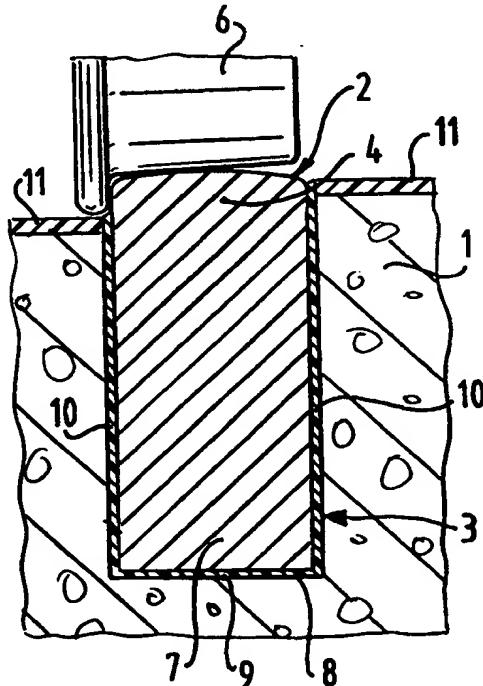
INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 6 : <b>E01B 19/00, 9/68, 1/00</b>	A1	(11) International Publication Number: <b>WO 99/01617</b> (43) International Publication Date: 14 January 1999 (14.01.99)
(21) International Application Number: <b>PCT/NL98/00368</b>		(81) Designated States: AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CU, CZ, DE, DK, EE, ES, FI, GB, GE, GH, GM, GW, HU, ID, IL, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, UA, UG, US, UZ, VN, YU, ZW, ARIPO patent (GH, GM, KE, LS, MW, SD, SZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, ML, MR, NE, SN, TD, TG).
(22) International Filing Date: <b>25 June 1998 (25.06.98)</b>		
(30) Priority Data: 1006483 4 July 1997 (04.07.97) NL		
(71) Applicant (for all designated States except US): NEDERLANDSE ORGANISATIE VOOR TOEGEPAST-NATUURWETENSCHAPPELIJK ONDERZOEK TNO [NL/NL]; Schoemakerstraat 97, NL-2628 VK Delft (NL).		Published With international search report. In English translation (filed in Dutch).
(72) Inventor; and		
(75) Inventor/Applicant (for US only): JANSSENS, Marcel, Henk, André [NL/NL]; v.d. Lelijstraat 27-I, NL-2614 ED Delft (NL).		
(74) Agent: HOORWEG, Petrus, Nicolaas; Arnold & Siedsma, Sweelinckplein 1, NL-2517 GK The Hague (NL).		

(54) Title: RAIL TRACK HAVING ENHANCED ABSORPTION OF VIBRATION AND SOUND

(57) Abstract

Rail track comprising at least two parallel rails (2) supported by a non-compressible base body (1), wherein the base body is provided with a channel-like recess for receiving the rail such that the running surface of the head of the rail lies free, wherein the bottom of the channel-like recess is provided with a first layer (9) of yielding material which extends under the bearing surface of the foot of the rail, and wherein the surface between the running surface and the bearing surface of the rail is covered with a second layer (10) of yielding material, so that an improved vibration damping and sound reduction are obtained.



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## RAIL TRACK HAVING ENHANCED ABSORPTION OF VIBRATION AND SOUND

The present invention relates to a rail track comprising at least two parallel rails supported by a non-compressible base body.

In many rail tracks the rails are connected with sleepers which lie on a base body, for instance gravel. An alternative is to mount the rails on a concrete slab or on a steel bridge.

Through rolling of the wheels of the train over the rails and as a result of the unevenness occurring on the wheels and rails, the wheels and the rails will be set into vibration. The vibrations in the rails become weaker as the distance relative to the contact point between wheel and the rail becomes larger. The reason that these vibrations become weaker is partly the result of dissipation in the rail but is caused to a much greater extent because the energy from the rail related to the vibrations is discharged to the base body via the rail support. A part of this discharged energy will be dissipated in the rail supports themselves and a part of this energy will be dissipated in the base body.

A resilient element is generally arranged between the rails and the sleepers, the concrete slab or the steel bridge. This is done to reduce the exchange of forces from the rail to the base body, whereby the lifespan of the rail and the base body is prolonged. For this purpose the railway companies for instance apply the regulation that the rails must undergo a displacement of 1.5 to 2.5 mm at an axle load of 22.5 tons.

In addition, the transfer of vibrations to the base body is reduced by this resilient rail support. The resilient element insulates the vibrations, which results in a reduction of the vibration level of the base body and to a reduction in the sound radiation from the base body. The result of a better vibration insulation is that

the rail will begin to vibrate more strongly and therefore becomes a more significant source of noise.

Another sound-damping system for rail tracks known from the prior art is casting flexible material in the rail. This system has the drawback that the rail begins to radiate sound more efficiently because the casting mass acts as reflector for the sound radiated by the rail and because the casting mass begins to function as an extra source of noise. In addition, use is made herein of a large volume of expensive polymer material to fix the rail.

On the basis of the foregoing, it can be concluded that acoustic measures will have to be taken in a balanced manner in order to reduce the total noise level of all sources together and to obtain an improved vibration damping of the rail track.

The object of the present invention is to achieve a reduction in the noise production of rail tracks while still complying with the regulation of the railway companies. For this purpose a rail track is provided wherein the base body is provided with a channel-like recess for receiving the rail such that the running surface of the head of the rail lies free, wherein the bottom of the channel-like recess is provided with a first layer of yielding material which extends under the bearing surface of the foot of the rail, and wherein the surface between the running surface and the bearing surface of the rail is covered with a second layer of yielding material.

Since only the running surface of the head of the rail lies free, the sound-radiating surface of the rail is reduced. The layer also radiates a minimum of noise because the surface making contact with the air is minimal. In addition, energy is better dissipated by the layer in that this is in contact with the non-compressible base body. Finally, a sufficiently large static settlement can be achieved by the first yielding layer, this being a requirement of the railway companies. In addition, the thinner the layer, the better the dissipation and thus also the better the vibration damping of the rail. A thinner layer has the second advantage that a

minimal volume of expensive polymer material is required to embed the rail in the base body.

When a rail is used with a non-releasing form, such as the I-shaped rail known from the prior art, it is 5 advantageous for arrangement of the rail in the base body to provide herein a rectangular channel-like recess, whereafter the space between the second layer and the channel-like recess is filled with a filler body of non-compressible material. In this manner the thin layer 10 remains coupled to the non-compressible base body in improved manner and the above stated advantages are preserved.

The second layer preferably has a greater stiffness than the first layer. The stiffness of both layers is 15 preferably as high as possible so that maximum dissipation can be obtained. The stiffness in vertical direction is however bounded by the regulation of the railway companies relating to the displacement under load of the rail vehicle. The material of the yielding layers must 20 therefore be chosen such that the static/quasi-static requirement can be satisfied while at the same time the greatest possible acoustic stiffness is provided. For the horizontal direction the stiffness of the second layer may only be bounded by the fact that this layer must 25 still be able to shear sufficiently to allow the vertical displacement.

The second layer preferably has on the one side of the rail a different stiffness than on the other side. A coupling is hereby obtained between vertical and horizontal vibrations, which is more advantageous for the damping of formerly substantially vertical rail vibrations, 30 so that an even better vibration damping is provided.

Another possibility of obtaining a coupling between vertical and horizontal vibrations is to make use of a 35 rail with an asymmetrical cross-section.

For determined forms of rail it can be advantageous to embody the first and/or second layer of yielding material in interrupted manner so as to be able to comply with the regulations of the railway companies and also to

be able to obtain an improved vibration damping and sound reduction.

It has already been noted above that the advantage of embedding the rail with a yielding layer in a non-compressible base body is that the sound-radiating surface of the rail is hereby reduced. However, the base body now acts as reflector for the sound which is radiated by the head of the rail. The upper side of the base body can therefore be provided with a layer of sound-absorbing material.

The present invention will be further elucidated with reference to the annexed drawing. In the drawing:

fig. 1 shows a partial cross-section of a first embodiment of the rail track according to the present invention;

fig. 2 shows a partial cross-section of a second embodiment of the rail track according to the present invention;

fig. 3 shows a partial cross-section of a third embodiment of the rail track according to the present invention;

fig. 4 shows a partial cross-section of a fourth embodiment of the rail track according to the present invention;

fig. 5 shows a partial cross-section of a fifth embodiment of the rail track according to the present invention, and

fig. 6 shows a partly perspective view of the rail track according to the embodiment of fig. 1.

Corresponding components are designated in the drawing with the same reference numeral. A rail 2 is supported in a non-compressible base body 1, for instance of concrete. In order to support rail 2 a channel-like recess 3 is provided in base body 1. Rail 2 has a head 4 having on the top part thereof a running surface 5 for a wheel 6 of a rail vehicle (see fig. 1 and 5). A first layer of yielding material 9 is provided between the foot 7 of rail 2 and the bottom 8 of channel-like recess 3. The surface between running surface 5 and the foot 7 of the rail is covered with a second layer of yielding

material 10. The top side of base body 1 is provided with a layer of sound-absorbing material 11.

The first embodiment of fig. 1 shows a rectangular rail 2 with a curved running surface 5 on which wheel 6 of a rail vehicle supports. With the exception of running surface 5, the periphery of rail 2 is covered with a thin later of yielding material 9, 10, wherein the second layer on the inside and outside of the rail has a greater stiffness than the first layer on the underside of rail 2. The stiffness of the first layer is bounded by railway company regulations relating to the displacement under load of the rail vehicle, for instance 1.5 to 2.5 mm at an axle load of 22.5 ton. The stiffness of the second layer 10 is only bounded by the fact that the material must still be able to shear sufficiently to allow vertical displacement. In addition, the material of the first yielding layer 9 and the second yielding layer 10 is chosen such that the highest possible acoustic stiffness is obtained in both horizontal and vertical directions. The open surface of the layer on the top side of the base body is minimal, whereby the layer radiates a minimum of noise. In addition, the layer dissipates vibrations better owing to the chosen material properties thereof, because the layer is coupled to a high-impedance base body and because the rail is completely enclosed, whereby horizontal vibrations are effectively damped.

Fig. 2 shows a second embodiment of the present invention, wherein a rail 2 known from the prior art is received in a rectangular channel-like recess 3. Once rail 2 with its covering has been arranged in channel-like recess 3 the space between second layer 10 and channel-like recess 3 is filled with a filler body 12 of non-compressible material. This can be the same material as that of base body 1 but has in any case a greater stiffness than second layer 10. According to the present invention one of both or both layers can take an interrupted form. In the embodiment of fig. 2 this is the case for first layer 9.

In a third embodiment of the present invention in fig. 3, use is made of another rail 2 which is more

flexible, i.e. has a lower moment of inertia, than the rail 2 of fig. 2 known from the prior art. Because a more flexible rail 2 is used, the first and second layer 9, 10 and base body 1 can be given a stiffer form, which results in an even better vibration damping.

The fourth embodiment of the present invention of fig. 4 shows, as does the third embodiment, a rail 2 with an asymmetrical form. Owing to the asymmetrical form of rail 2 a coupling is obtained between the vertical and horizontal vibrations, which is once again more favourable for the damping of vibrations. The advantage of the rail 2 used in the fourth embodiment is that it has a releasing form.

The fifth embodiment of fig. 5 shows a rail known from the prior art wherein the web recess of the rail is filled with extra mass 13. In this case the rail is formed by the I-profile and the mass. The rail is again covered with a layer of yielding material 9,10 and supported in a channel-like recess 3, wherein the space between second layer 10 and channel-like recess 3 is filled with a filler body 12.

Fig. 6 shows a partly perspective view of the rail track according to the present invention in accordance with the first embodiment of fig. 1.

The stiffness of the layers of yielding material can vary along the periphery of the rail if this is required in order to comply with railway company regulations and also to obtain an improved vibration damping and noise reduction.

It is also possible to line the bottom of the channel-like recess with one or other material before arranging the rail with its covering. This may for instance be necessary from a structural point of view or be required by the railway companies. In this case the bottom of the channel-like recess is formed by the top side of this lining.

A rail track according to the present invention is expected to achieve a noise reduction in the order of 5 decibels (A) on the rail noise relative to a normal rail track.

## CLAIMS

1. Rail track comprising at least two parallel rails supported by a non-compressible base body, characterized in that the base body is provided with a channel-like recess for receiving the rail such that the running 5 surface of the head of the rail lies free, wherein the bottom of the channel-like recess is provided with a first layer of yielding material which extends under the bearing surface of the foot of the rail, and wherein the surface between the running surface and the bearing 10 surface of the rail is covered with a second layer of yielding material.

2. Rail track as claimed in claim 1, characterized in that the space between the second layer and the channel-like recess is filled with a filler body of non- 15 compressible material.

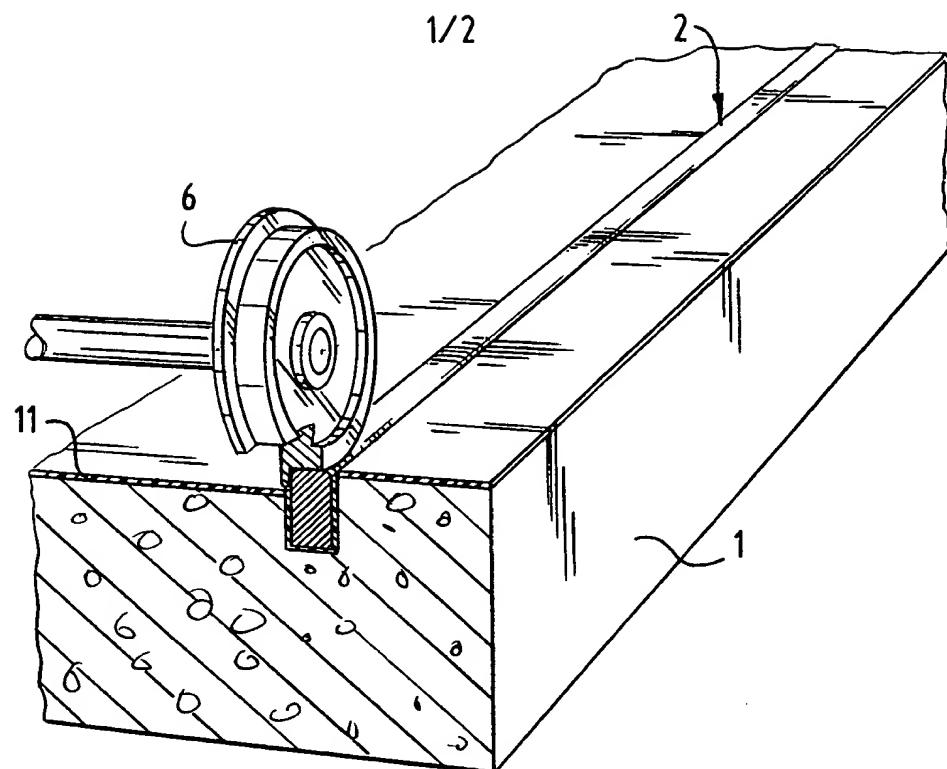
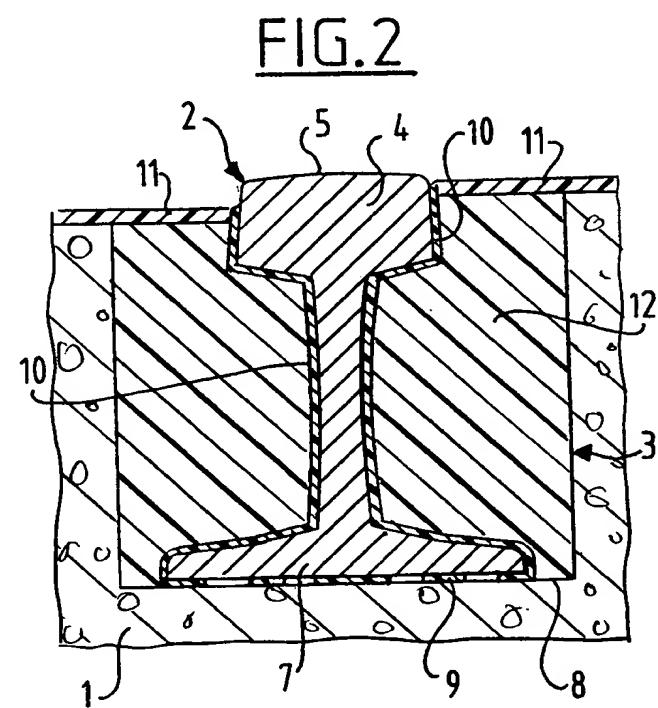
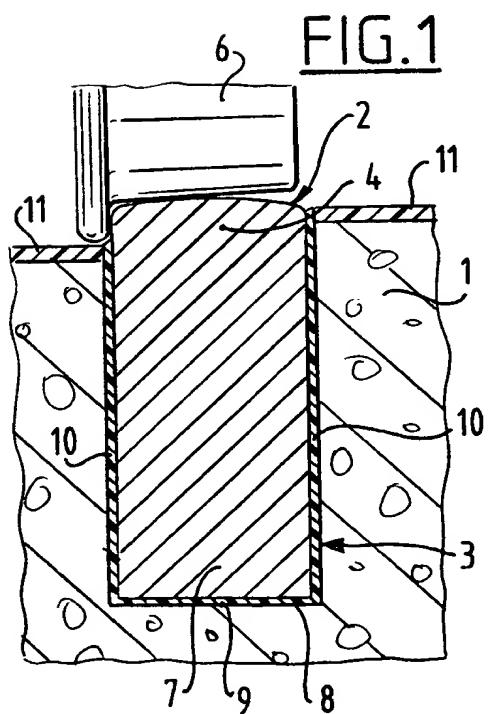
3. Rail track as claimed in claim 1 or 2, characterized in that the second layer has a greater stiffness than the first layer.

4. Rail track as claimed in any of the foregoing 20 claims, characterized in that the second layer has on the one side of the rail a different stiffness than on the other side.

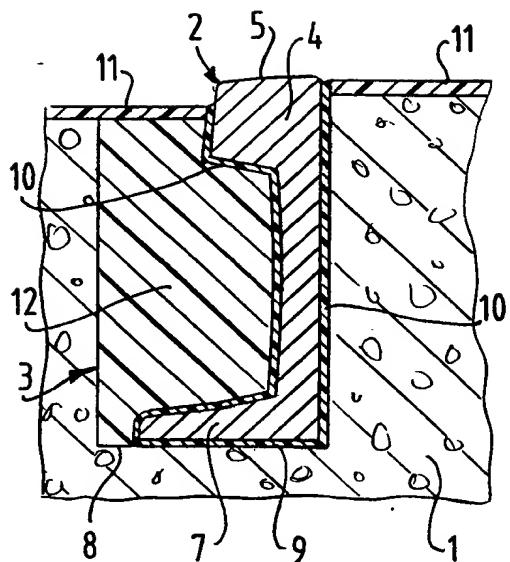
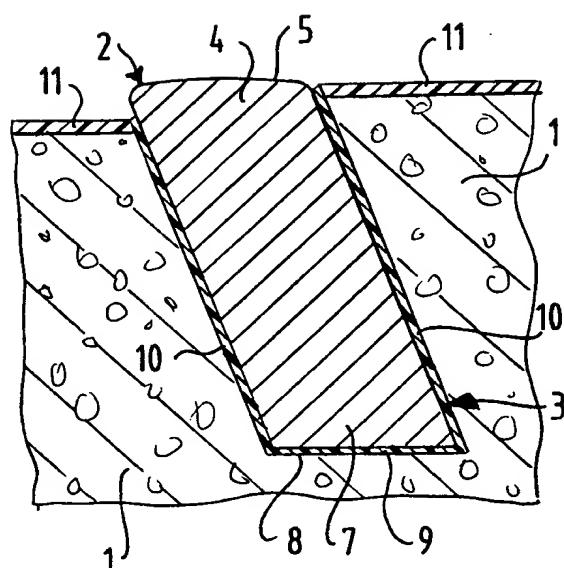
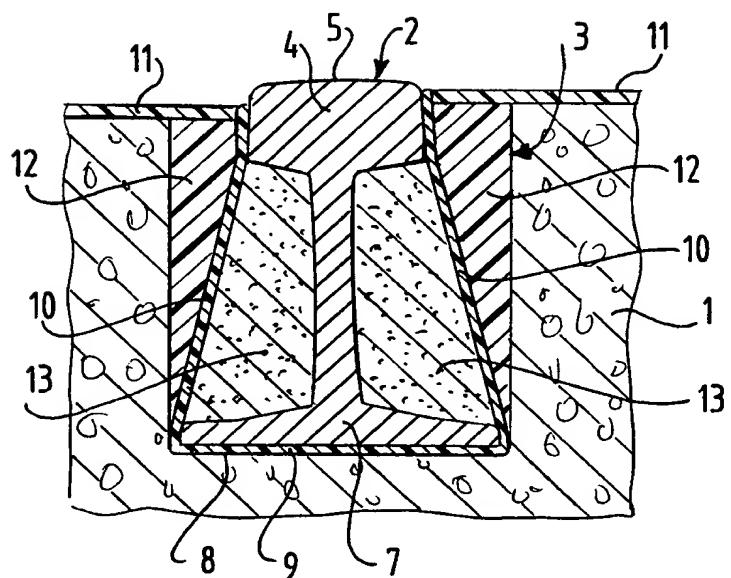
5. Rail track as claimed in any of the foregoing claims, characterized in that the cross-section of the 25 rail is asymmetrical.

6. Rail track as claimed in any of the foregoing claims, characterized in that the first and/or second layer of yielding material is interrupted.

7. Rail track as claimed in any of the foregoing 30 claims, characterized in that the upper side of the base body is provided with a layer of sound-absorbing material.

FIG.6

2/2

FIG. 3FIG. 4FIG. 5

# INTERNATIONAL SEARCH REPORT

Application No  
PCT/NL 98/00368

**A. CLASSIFICATION OF SUBJECT MATTER**  
 IPC 6 E01B19/00 E01B9/68 E01B1/00

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Category	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 91 10778 A (BRITISH STEEL) 25 July 1991 see page 2, line 1 - page 4, line 20; figure 1 ---	1,3-5
X	DE 916 830 C (DORTMUNDER UNION BRÜCKENBAU) 3 December 1953 see page 2, line 1-29; figure 1 ---	1,3-5
X	US 5 513 797 A (LESLEY) 7 May 1996 see column 2, line 64 - column 3, line 53; figures 1,2 ---	1,5,7
A	US 4 775 103 A (ORTWEIN) 4 October 1988 see column 5, line 1-6; figure 3 ---	1-3
A	DE 44 15 892 C (BAUUNTERNEHMUNG E.HEITKAMP) 17 August 1995 see figures 1,5 ---	6
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## C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

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A	EP 0 771 908 A (STICHTING GELUIDARME SPOORBRUGGEN) 7 May 1997 -----	

## INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No  
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Rail track having enhanced absorption of vibration and sound

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<b>Box No. VI PRIORITY CLAIM</b>		Further priority claims are indicated in the Supplemental Box <input type="checkbox"/>	
The priority of the following earlier application(s) is hereby claimed:			
Country (in which, or for which, the application was filed)	Filing Date (day/month/year)	Application No.	Office of filing (only for regional or international application)
item (1) The Netherlands	4 July 1997 (04.07.97)	1006483	
item (2)			
item (3)			

Mark the following check-box if the certified copy of the earlier application is to be issued by the Office which for the purposes of the present international application is the receiving Office (a fee may be required):

The receiving Office is hereby requested to prepare and transmit to the International Bureau a certified copy of the earlier application(s) identified above as item(s): 1

#### Box No. VII INTERNATIONAL SEARCHING AUTHORITY

Choice of International Searching Authority (ISA) (If two or more International Searching Authorities are competent to carry out the international search, indicate the Authority chosen; the two-letter code may be used): ISA /

Earlier search Fill in where a search (international, international-type or other) by the International Searching Authority has already been carried out or requested and the Authority is now requested to base the international search, to the extent possible, on the results of that earlier search. Identify such search or request either by reference to the relevant application (or the translation thereof) or by reference to the search request:

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The Netherlands 11 February 1998 SN 29848 NL

#### Box No. VIII CHECK LIST

This international application contains the following number of sheets:	This international application is accompanied by the item(s) marked below:
1. request : 3 sheets 2. description : 7 sheets NL 3. claims : 1 sheets NL 4. abstract : 1 sheets NL 5. drawings : 2 sheets  Total : 14 sheets	1. <input type="checkbox"/> separate signed power of attorney 2. <input type="checkbox"/> copy of general power of attorney 3. <input type="checkbox"/> statement explaining lack of signature 4. <input checked="" type="checkbox"/> priority document(s) identified in Box No. VI as item(s): 1 5. <input checked="" type="checkbox"/> fee calculation sheet 6. <input type="checkbox"/> separate indications concerning deposited microorganisms 7. <input type="checkbox"/> nucleotide and/or amino acid sequence listing (diskette) 8. <input type="checkbox"/> other (specify):

Figure No. 6 of the drawings (if any) should accompany the abstract when it is published.

#### Box No. IX SIGNATURE OF APPLICANT OR AGENT

Next to each signature, indicate the name of the person signing and the capacity in which the person signs (if such capacity is not obvious from reading the request):

Hoorweg, Petrus Nicolaas

For receiving Office use only		
1. Date of actual receipt of the purported international application:	25 JUN 1998	25.06.98
3. Corrected date of actual receipt due to later but timely received papers or drawings completing the purported international application:		
4. Date of timely receipt of the required corrections under PCT Article 11(2):		
5. International Searching Authority specified by the applicant:	ISA /	6. <input type="checkbox"/> Transmittal of search copy delayed until search fee is paid

2. Drawings:

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Mt/ ki/1

Spoorbaan met verbeterde trillingsdemping  
en geluidsreductie

De onderhavige uitvinding betreft een spoorbaan omvattende tenminste een tweetal parallelle, door een onsamendrukbaar onderlichaam ondersteunde spoorstaven.

- Bij veel spoorbanen zijn de spoorstaven verbon-
- 5 den met dwarsliggers welke op een onderlichaam, bijvoor-  
beeld grint, liggen. Een alternatief is om de spoorstaven te bevestigen op een betonplaat of op een stalen brug.

Door het rollen van de wielen van de trein over de spoorstaven en ten gevolge van de op de wielen en

10 spoorstaven voorkomende oneffenheden zullen de wielen en de spoorstaven in trilling worden gebracht. De trillingen in de spoorstaven worden zwakker naarmate de afstand ten opzichte van het contactpunt tussen de wiel en de spooraaf groter wordt. De reden dat deze trillingen zwakker

15 worden is deels het gevolg van dissipatie in de spooraaf, maar wordt in veel grotere mate veroorzaakt doordat de aan de trillingen gerelateerde energie van de spooraaf wordt afgevoerd naar het onderlichaam via de spooraafoplegging. Een deel van deze afgevoerde energie

20 zal gedissipeerd worden in de spooraafopleggingen zelf en een deel van deze energie wordt gedissipeerd in het onderlichaam.

Tussen de spoorstaven en de dwarsliggers, de betonplaat of de stalen brug wordt over het algemeen een

25 verend element aangebracht. Dit wordt gedaan om de krachtwisselingen van de spooraaf op het onderlichaam te verminderen, waardoor de levensduur van de spooraaf en het onderlichaam wordt verlengd. Hiervoor hanteert het railv rvoerbedrijf bijvoorbeeld het voorschrift dat de

30 spoorstavenverplaatsing van 1,5 tot 2,5 mm bij een aslast van 22,5 ton moet ondergaan.

Daarnaast wordt door deze verende railoplegging doorgifte van trillingen naar het onderlichaam verminderd. Het verend element isoleert de trilling niet tegen tot een verlaging van het trillingsniveau van het onderlichaam en tot een reductie van de geluidsafstraling van het onderlichaam leidt. Het gevolg van een betere trillingsisolatie is dat de spoorstaaf sterker zal gaan trillen en derhalve een belangrijkere geluidsbron wordt.

Een ander uit de stand van de techniek bekend geluiddempend systeem voor spoorbanen is het ingieten van de spoorstaaf met flexibel materiaal. Dit systeem heeft als nadeel dat de spoorstaaf efficiënter geluid gaat afstralen, doordat de ingietmassa als reflector werkt voor het door de spoorstaaf afgestraald geluid, en dat de ingietmassa als een extra geluidsbron gaat fungeren.

Daarnaast wordt hierbij gebruik gemaakt van een groot volume kostbaar polymeermateriaal om de spoorstaaf te bevestigen.

Aan de hand van wat boven beschreven is kan worden geconcludeerd dat akoestische maatregelen gebalanceerd genomen zullen moeten worden teneinde het totale geluidsniveau van alle bronnen gezamen te reduceren en een verbeterde trillingsdemping van de spoorbaan te verkrijgen.

Het doel van de onderhavige uitvinding is een afname van de geluidsproductie van spoorbanen met inachtneming van het voorschrift van het railvervoerbedrijf te bewerkstelligen. Daartoe is een spoorbaan verschaft waarbij het onderlichaam is voorzien van een kanaalvormige uitsparing voor het opnemen van de spoorstaaf, zodanig dat het loopvlak van de kop van de spoorstaaf vrij ligt, waarbij de bodem van de kanaalvormige uitsparing is voorzien van een eerste laag meegevend materiaal, dat zich onder het draagvlak van de voet van de spoorstaaf uitstrekkt, en waarbij het oppervlak tussen het loopvlak en het draagvlak van de spoorstaaf is bedekt met een tweede laag meegevend materiaal.

Aangezien slechts het 1 pvlak van de kop van d spoorstaaf vrij ligt, is het geluidsafstralend oppervlak van de rail verkleind. Ook de laag straalt minimaal geluid af, doordat het met de lucht in verbinding staand 5 oppervlak minimaal is. Daarnaast wordt door de laag beter energie gedissipeerd, doordat deze in contact is met het onsamendrukbaar onderlichaam. Tenslotte kan door de eerste meegevende laag een voldoende grote statische zakking worden bereikt, wat door het railvervoerbedrijf 10 wordt geëist. Daarnaast geldt hoe dunner de laag is des te beter de dissipatie en dus ook des te beter de trillingsdemping van de spoorstaaf is. Een dundere laag heeft als tweede voordeel dat een minimaal volume kostbaar 15 polymeermateriaal nodig is om de spoorstaaf in het onderlichaam in te bedden.

Wanneer een spoorstaaf met een niet-lossende vorm, zoals de uit de stand van de techniek bekende, I-vormige spoorstaaf, wordt gebruikt, is het voor het aanbrengen van de spoorstaaf in het onderlichaam voordeel 20 lig om hierin een rechthoekige kanaalvormige uitsparing te voorzien, waarna de ruimte tussen de tweede laag en de kanaalvormige uitsparing wordt gevuld met een vullichaam van onsamendrukbaar materiaal. Op deze wijze blijft de dunne laag verbeterd gekoppeld aan het onsamendrukbare 25 onderlichaam en worden de boven genoemde voordelen gehandhaafd.

Bij voorkeur heeft de tweede laag een grotere stijfheid dan de eerste laag. Bij voorkeur is de stijfheid van de beide lagen zo hoog mogelijk zodat de maximale dissipatie kan worden verkregen. De stijfheid in verticale richting is echter begrensd door het voor- 30 schrift van het railvervoerbedrijf met betrekking tot de verplaatsing bij belasting door het railvoertuig. Het materiaal van de meegevende lagen dient dus zodanig te 35 worden gekozen dat aan de statische/quasi-statische eis kan worden voldaan maar dat tegelijkertijd een zo hoog mogelijke akoestische stijfheid is verschaft. Voor de horizontal richting mag de stijfheid van de tweede laag

slechts begrensd worden door het feit dat deze nog voldoend moet kunnen afschuiven om de verticale verplaatsing toe te laten.

Bij voorkeur heeft de tweede laag aan de ene zijde van de spoorstaaf een andere stijfheid dan aan de andere zijde. Hierdoor wordt een koppeling verkregen tussen verticale en horizontale trillingen, wat gunstiger is voor de demping van voorheen hoofdzakelijk verticale spoorstaaftrillingen, zodat een nog betere trillingsdemping wordt verschaft.

Een andere mogelijkheid om een koppeling tussen verticale en horizontale trillingen te verkrijgen, is gebruik te maken van een spoorstaaf met een asymmetrische dwarsdoorsnede.

Voor bepaalde spoorstaafvormen kan het voordelig zijn om de eerste en/of tweede laag meegevend materiaal onderbroken uit te voeren om aan de voorschriften van het railvervoerbedrijf te kunnen voldoen en daarnaast een verbeterde trillingsdemping en geluidsreductie te kunnen verkrijgen.

Hierboven werd reeds beschreven dat het voordeel van het inbedden van de spoorstaaf met een meegevende laag in een onsamendrukbare onderlichaam is dat hierdoor het geluidsafstralend oppervlak van de spoorstaaf wordt verkleind. Het onderlichaam werkt echter nu als reflector voor het geluid dat wordt afgestraald door de kop van de spoorstaaf. Daarom kan de bovenzijde van het onderlichaam voorzien worden van een laag geluidsabsorberend materiaal.

De onderhavige uitvinding zal aan de hand van de bijgevoegde tekening nader worden verduidelijkt. In de tekening toont:

fig. 1 een gedeeltelijke dwarsdoorsnede van een eerste uitvoeringsvorm van de spoorbaan volgens de onderhavige uitvinding;

fig. 2 een gedeeltelijke dwarsdoorsnede van een tweede uitvoeringsvorm van de spoorbaan volgens de onderhavige uitvinding;

fig. 3 een gedeeltelijke dwarsdoorsnede van een derd uitvoeringsvorm van de spoorbaan volgens de onderhavige uitvinding;

fig. 4 een gedeeltelijke dwarsdoorsnede van een 5 vierde uitvoeringsvorm van de spoorbaan volgens de onderhavige uitvinding;

fig. 5 een gedeeltelijke dwarsdoorsnede van een vijfde uitvoeringsvorm van de spoorbaan volgens de onderhavige uitvinding, en

10 fig. 6 een gedeeltelijk perspectivisch aanzicht van de spoorbaan volgens de uitvoeringsvorm van fig. 1.

In de tekening zijn overeenkomstige onderdelen met hetzelfde verwijzingscijfer aangeduid. In een onsamendrukbaar onderlichaam 1, bijvoorbeeld van beton, 15 wordt een spoorstaaf 2 ondersteund. Voor het ondersteunen van de spoorstaaf 2 is in het onderlichaam 1 een kanaalvormige uitsparing 3 voorzien. De spoorstaaf 2 heeft een kop 4 met aan de bovenzijde daarvan een loopvlak 5 voor een wiel 6 van een railvoertuig (zie fig. 1 20 en 5). Tussen de voet 7 van de spoorstaaf 2 en de bodem 8 van de kanaalvormige uitsparing 3 is een eerste laag meegevend materiaal 9 voorzien. Het oppervlak tussen het loopvlak 5 en de voet 7 van de spoorstaaf is bedekt met een tweede laag meegevend materiaal 10. De bovenzijde van 25 het onderlichaam 1 is voorzien van een laag geluidsabsorberend materiaal 11.

De eerste uitvoeringsvorm van fig. 1 toont een rechthoekige spoorstaaf 2 met een gekromd loopvlak 5 waarop het wiel 6 van een railvoertuig zich afsteunt.

30 Afgezien van het loopvlak 5 is de omtrek van de spoorstaaf 2 bedekt met een dunne laag meegevend materiaal 9, 10, waarbij de tweede laag aan de binnen- en buitenzijde van de spoorstaaf een grotere stijfheid heeft dan de eerste laag aan de onderzijde van de spoorstaaf 2. De 35 stijfheid van de eerste laag is begrensd door voor- schriften van het railvervoerbedrijf met betrekking tot de verplaatsing bij belasting door het railvoertuig, bijvoorbeeld 1,5 tot 2,5 mm bij een last van 22,5 ton. De

stijfheid van de tweede laag 10 wordt slechts begr nsd door het feit dat het materiaal nog voldoende moet kunnen afschuiven om de vertical verplaatsing toe te laten. Daarnaast wordt het materiaal van de eerste meegevende 5 laag 9 en de tweede meegevende laag 10 zodanig gekozen dat zowel in horizontale richting als ook in verticale richting een zo hoog mogelijke akoestische stijfheid wordt bereikt. Het open oppervlak van de laag aan de bovenzijde van het onderlichaam is minimaal, waardoor de 10 laag minimaal geluid afstraalt. Daarnaast dissipeert de laag verbeterd trillingen door de gekozen materiaaleigen- schappen daarvan, doordat de laag is gekoppeld aan een hoog impedante onderlichaam, en doordat de spoorstaaf volledig is ingesloten, waardoor horizontale trillingen 15 effectief worden gedempt.

In fig. 2 wordt een tweede uitvoeringsvorm van de onderhavige uitvinding getoond, waarbij een uit de stand van de techniek bekende spoorstaaf 2 is opgenomen in een rechthoekige kanaalvormige uitsparing 3. Nadat de 20 spoorstaaf 2 met zijn bekleding in de kanaalvormige uitsparing 3 is aangebracht wordt de ruimte tussen de tweede laag 10 en de kanaalvormige uitsparing 3 gevuld met een vullichaam 12 van onsamendrukbaar materiaal. Dit kan hetzelfde materiaal zijn als dat van het onderlichaam 25 1 maar heeft in ieder geval een hogere stijfheid dan de tweede laag 10. Volgens de onderhavige uitvinding kan één van beide of kunnen beide lagen onderbroken zijn uitgevoerd. In de uitvoeringsvorm van fig. 2 is dit het geval voor de eerste laag 9.

30 In een derde uitvoeringsvorm van de onderhavige uitvinding van fig. 3 is gebruikt gemaakt van een andere spoorstaaf 2, welke buigslapper is, dat wil zeggen een kleiner traagheidsmoment heeft, dan de uit de stand van de techniek bekende spoorstaaf 2 van fig. 2. Doordat een 35 slapper spoorstaaf 2 is gebruikt kunnen de eerste en tweed laag 9, 10 en het onderlichaam 1 stijver worden uitgevoerd hetgeen een nog betere trillingsdemping tot gevolg heeft.

De vierde uitvoeringsvorm van de onderhavige uitvinding van fig. 4 toont venals d derde uitvoeringsvorm een spoorstaaf 2 met een asymmetrische vorm. Door de asymmetrische vorm van de spoorstaaf 2 wordt een koppling verkregen tussen de verticale en horizontale trillingen wat wederom gunstiger is voor het dempen van de trillingen. Het voordeel van de in de vierde uitvoeringsvorm gebruikte spoorstaaf 2 is dat deze een lossende vorm heeft.

De vijfde uitvoeringsvorm van fig. 5 toont een uit de stand van de techniek bekende spoorstaaf, waarbij de ziel van de spoorstaaf is opgevuld met extra massa 13. In dit geval wordt de spoorstaaf gevormd door het I-profiel en de massa. De spoorstaaf is wederom bekleed met een laag meegevend materiaal 9,10 en in een kanaalvormige uitsparing 3 ondersteund, waarbij de ruimte tussen de tweede laag 10 en de kanaalvormige uitsparing 3 is gevuld met een vullichaam 12.

Fig. 6 toont een gedeeltelijk perspectivisch aanzicht van de spoorbaan volgens de onderhavige uitvinding volgens de eerste uitvoeringsvorm van fig. 1.

De stijfheden van de lagen meegevend materiaal kunnen langs de omtrek van de spoorstaaf variëren, als dit wordt vereist om aan de voorschriften van het railvervoerbedrijf te voldoen en tevens een verbeterde trillingsdemping en geluidsreductie te verkrijgen.

Tevens is het mogelijk de bodem van de kanaalvormige uitsparing te bekleden met een of ander materiaal alvorens de spoorstaaf met zijn bekleding aan te brengen. Dit kan bijvoorbeeld noodzakelijk zijn vanuit constructief oogpunt gezien of door het railvervoerbedrijf vereist zijn. In dit geval wordt de bodem van de kanaalvormige uitsparing gevormd door de bovenzijde van deze bekleding.

Met een spoorbaan volgens de onderhavige uitvinding wordt verwacht een geluidsreductie te behalen in de orde van 5 decibel (A) op het spoorg luid ten opzichte van een normale spoorbaan.

### Conclusies

1. Spoorbaan omvattende tenminste een tweetal parallelle, door een onsamendrukbaar onderlichaam ondersteunde spoorstaven, met het kenmerk, dat het onderlichaam is voorzien van een kanaalvormige uitsparing voor 5 het opnemen van de spoorstaaf, zodanig dat het loopvlak van de kop van de spoorstaaf vrij ligt, waarbij de bodem van de kanaalvormige uitsparing is voorzien van een eerste laag meegevend materiaal, dat zich onder het draagvlak van de voet van de spoorstaaf uitstrekkt, en 10 waarbij het oppervlak tussen het loopvlak en het draagvlak van de spoorstaaf is bedekt met een tweede laag meegevend materiaal.

2. Spoorbaan volgens conclusie 1, met het kenmerk, dat de ruimte tussen de tweede laag en de 15 kanaalvormige uitsparing is gevuld met een vullichaam van onsamendrukbaar materiaal.

3. Spoorbaan volgens conclusie 1 of 2, met het kenmerk, dat de tweede laag een grotere stijfheid heeft dan de eerste laag.

20 4. Spoorbaan volgens een van de voorafgaande conclusies, met het kenmerk, dat de tweede laag aan de ene zijde van de spoorstaaf een andere stijfheid heeft dan aan de andere zijde.

25 5. Spoorbaan volgens een van de voorafgaande conclusies, met het kenmerk, dat de dwarsdoorsnede van de spoorstaaf asymmetrisch is.

6. Spoorbaan volgens een van de voorafgaande conclusies, met het kenmerk, dat de eerste en/of tweede laag meegevend materiaal onderbroken is.

30 7. Spoorbaan volgens een van de voorafgaande conclusies, met het kenmerk, dat de bovenzijde van het onderlichaam is voorzien van een laag geluidsabsorberend materiaal.

## Uitruksel

Spoorbaan gevattende tenminste in twee tal parallelle, door een onsamendrukbaar onderlichaam ondersteunde spoorstaven waarbij het onderlichaam is voorzien van een kanaalvormige uitsparing voor het 5 opnemen van de spoorstaaf, zodanig dat het loopvlak van de kop van de spoorstaaf vrij ligt, waarbij de bodem van de kanaalvormige uitsparing is voorzien van een eerste laag meegevend materiaal, dat zich onder het draagvlak van de voet van de spoorstaaf uitstrekkt, en waarbij het 10 oppervlak tussen het loopvlak en het draagvlak van de spoorstaaf is bedekt met een tweede laag meegevend materiaal, zodat een verbeterde trillingsdemping en geluidsreductie is verschaft.

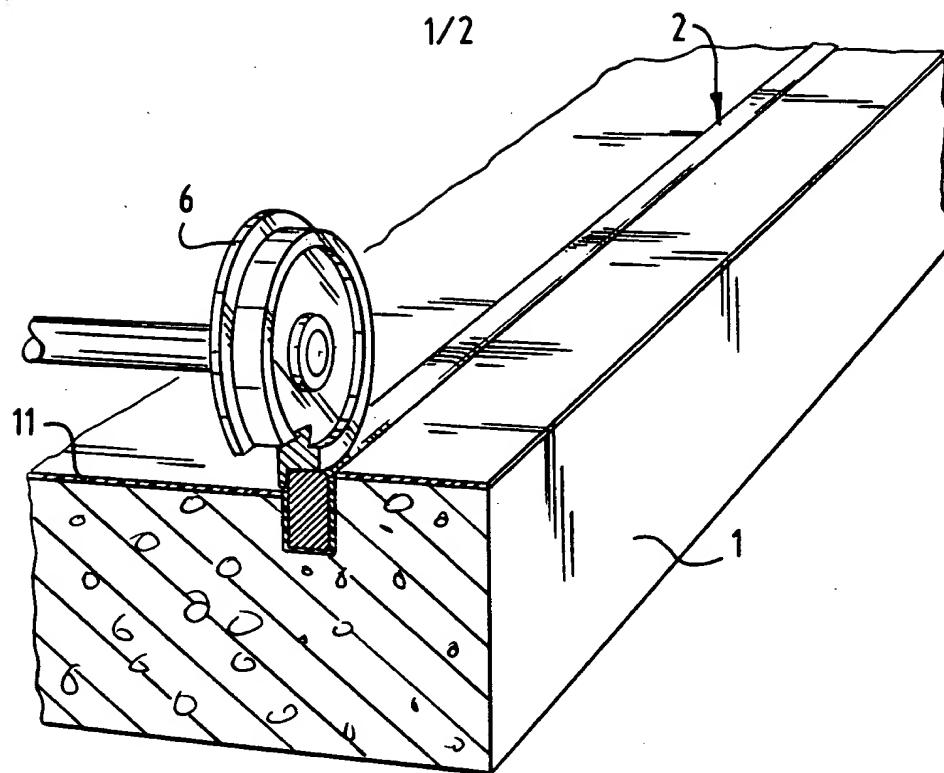
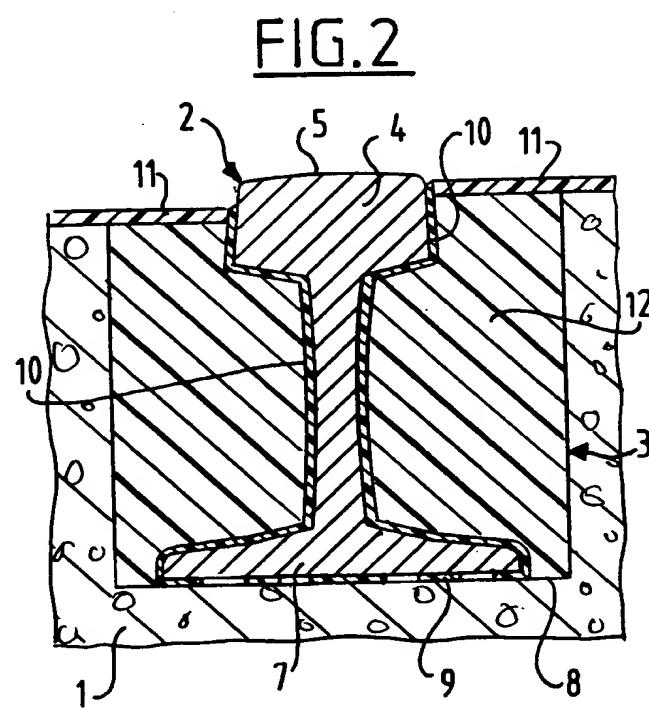
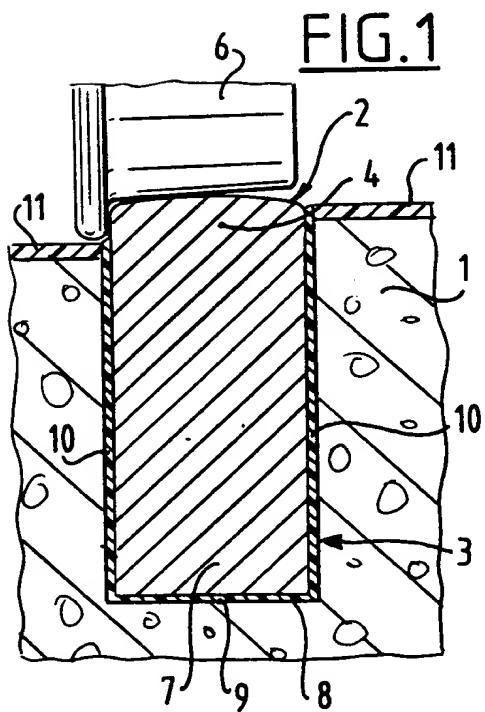


FIG.6



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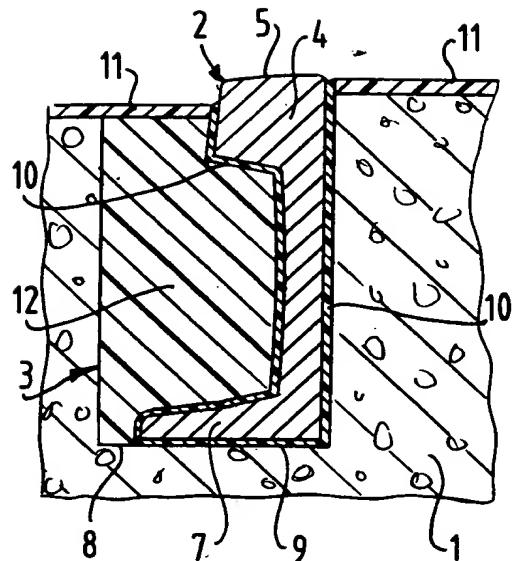


FIG.3

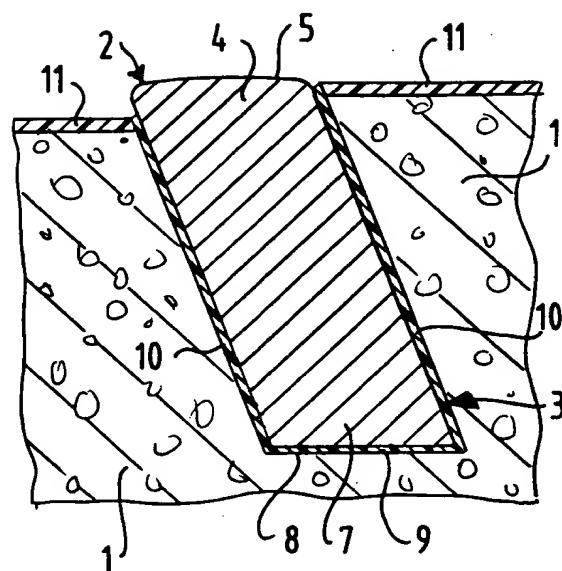


FIG.4

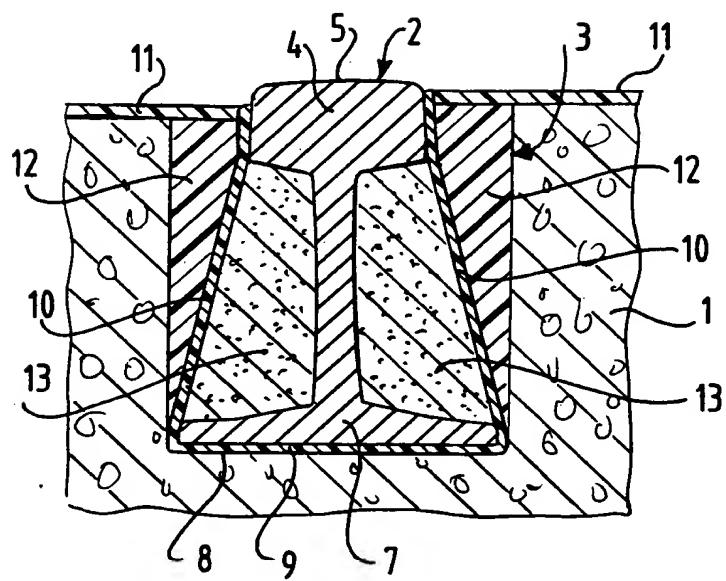


FIG.5